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Study of Swine Brucellosis Infection Rate in the Avan Community of Aragatsotn Region

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ABSTRACT

Investigations on the swine brucellosis has been conducted for the first time within 2021-2022 throughout the recent 60 years.

Probably, the infection carrier small and large cattle have become the cause of brucellosis infection. Joint housing and zoohygienic conditions, as well as the remnants of infected dairy products have served as predisposing factors for morbidity.

Rose-Bengal test and agglutination reaction were used to detect antibodies in blood serum. As a result of epidemiological analysis, the indicators of morbidity and insecurity rates have amounted to 0.0025 (0.25 %), 0.0075 (0.75 %), respectively, while the economic damage has made AMD 1 mln 310 thousand.

Introduction

The first information about the disease of brucellosis was reported by Hippocrates, whereas the English physician Bruce first introduced the characteristic traits of brucella (Grigoryan, 2002, Vardanyan, et al., 2017).

Malta (Mediterranean) fever was known to humanity still 500 years BC, but there hasn't been any effective measure identified yet for combating and preventing it.

According to the data of International Epidemiological Office, numerous countries, thousands of livestock farms and settlements are recognized as vulnerable towards brucellosis (Bessarabov, et al., 2007, Balabanova and Kudryashov, 2019).

It is known that brucellosis is a zoonotic endemic infectious and allergic disease with chronicity characterized by miscarriages, retained placenta, abscesses, endometritis and disorders of the reproductive function of animals. It is noteworthy that the causative agents of brucellosis are intracellular pathogenic bacteria, they propagate and persist in the host's phagocytic cells infecting the system of mononuclear phagocytes (lymph nodes, kidney, spleen and bone marrow) and monocytic cells (Kudryashova and Svyatkovskovo, 2007).

There are more than 6 types of brucella – biospecies: Br. Melitensis (3 biovars), Br.abortus (7 biovars), Br. Suis (5 biovars), Br. Ovis, Br. canis, Br. neotomae and marine mammals: Br. pinnipedialis, Br. Ceti, B. Microti

(3 biovars), which can be transmitted from one animal species to another one (Kolychev and Gosmanov, 2006, Michiel, et al., 2018). Among the abovementioned species Br. Melitensis, Br. abortus and Br. Suis are specifically positioned in the list of hazardous infectious diseases posing threat to human life (Dimov and Arakelyan, 2008). The infection risk degree in humans depends on the pathogen virulence of Br melitensis, Br. abortus, Br. Suis strains, which cause physical and mental disorders (Vershilva, 1961, Deghdzunyan and Hambardzumyan, 1990).

Over the past 20 years, swine brucellosis has become widespread in the developed pig farms of the Russian Federation (Volgograd, Voronezh, Rostov), as well as Australia, North and South America, New Zealand and other countries (Iskandarov, 2011), causing huge economic losses.

Porcine brucelli are also intracellular and sometimes extracellular pathogens that propagate in reticuloendothelial cells, causing cytopathological changes. According to pathogenicity, aggressiveness, immunological reconstructions, they are morphologically similar to the above-mentioned Brucella species. Br. Suis pathogens enter the body of animals through alimentary, mucosal, genitourinary, impaired skin integrity, and sometimes respiratory channels (Balabanova and Kudryashov, 2019).

Pigs diseased with brucellosis are characterized by limb paresis, abscesses, mummified and underdeveloped fetuses. Inflammation of the testicles is observed in wild boars, the weight of which amounts up to 2-4 kg (Bakulov, et al., 1984, Balabanova and Kudryashov, 2019).

Brucella can be transmitted to humans via the consumption of raw or undercooked and incompletely heat-processed meat products of the infected swine. Laboratory and slaughterhouse workers, also pig farmers can become infected through complete skin breakdown and inhalation of Brucella-contaminated dust. The disease in humans is associated with long-term fever and infection of musculoskeletal, cardiovascular, nervous, genitourinary and other organ systems.

Materials and methods

The first information about the swine brucellosis was provided by Traum (1914) and the bacteria isolated from the amniotic fluid of an aborted pig were named Br. abortis suis.

The causative agents of swine brucellosis belong to the family Brucellacaea, the genus Brucella, which are multi-shaped (spherical, ovoid, coliform) 0.6-1.5 μm, immobile, gram-negative, aerobic bacteria stained with aniline dyes. The pathogens grow well in the mediums of brucella agar, meat-pepton-liver-broth (MPLB), meat-pepton-liver-glucose-glycerol agar (MPLGGA) within 2-3 weeks and in case of double seeding even faster (Kudryashova and Svyatkovskovo, 2007, Grigoryan, 2002). Brucellosis of pigs is a zoonotic chronic, endemic, infectious disease and poses considerable threat to human health, so we have a task to study the brucellosis of pig farms in some regions of Armenia and prevent the spread of the infection.

Throughout the last 60 years, for the first time brucellosis carrier state of pigs has been studied and an epidemiological analysis has been carried out within 2020-2022 in Aragatsotn region of Armenia. In order to evaluate the epidemiological situation, the well-known methods of diagnosis were used: epidemiological observations, manifestations of clinical signs and serological reaction. As a result of investigations on the preventive measures for mass animal infection Rose Bengal test (RBT) and the agglutination reaction (AR) were used (Antonov, et al., 1986, Iskandarov, 2007, Popova, 2017, Balabanova and Kudryashov, 2019, Collection of Materials, 2020). Serological investigations were conducted in the central laboratory of the ANAU Scientific Center for Veterinary Medicine and Veterinary Sanitary Examination.

About 2000 units of swine stock aging from 3-month up to 1.5-year old were registered in the Avan community of Aragatsotn region. More than 200 blood samples, in the amount of 3-5 ml, were drawn from the swine breeding farms of the mentioned community (Figure 1). In the schedule of further studies, it is planned to determine the serological type of brucellosis by enzyme-linked immunosorbent assay (ELISA).

In order to exclude other diseases (colibacteriosis, salmonellosis, leptospirosis), the stomach contents, liver, spleen, kidney and femur bone marrow of immature (aborted), underdeveloped and fallen piglets were used as material (Figure 2). Smear-prints were produced from the abovementioned materials and observed by means of microscope. Nutrient media (MPA, MPB) and bismuth-sulfite agar were used for microbiological studies. (Antonov, et al., 1986).

Epidemiological analysis of the studied areas was performed per morbidity and insecurity coefficients, while economic damage was estimated per forced slaughter and infertility indicators (Nikitin and Voskoboynik, 1999, Grigoryan, 2005, Grigoryan, et al., 2004, Grigoryan, et al., 2017).

The morbidity index has been determined per the ratio of diseased animals and the total stock number of animals, while the insecurity coefficient – by the ratio of insecure

sites and the total farm numbers. The economic damage caused by forced slaughter and infertility was determined through formulae 1 and 2.

$$E_d = N \cdot K_m \cdot P - D_{in}, \quad (1)$$

where E_d is the economic damage, N is the number of infected pigs – 5 units, Km is the average mass of the mentioned pigs – 80 kg, P is the price of the unit product sold – 2500 drams, D_{in} – is the money income generated from the sold meat carcass – 600 thousand drams.

$$E_d = F_p \cdot (P_c \cdot S_n - F_b), \quad (2)$$

where E_d is the economic damage, F_p is the price of a fetus unit at the farrowing time, P_c is the planned fertility rate (8 piglets for uniparous sows), S_n is the number of sows to give birth – 200 heads, F_b is the number of factually born piglets – 1560 heads.

It should be mentioned that the infection of swine brucellosis is probably related to the joint housing of large and small cattle/ruminants and veterinary-sanitary conditions. Recovery of farms vulnerable to brucellosis is organized as a result of successive check-outs (serological). Animals with a suspected positive reaction were isolated and subjected to forced slaughter, and an aqueous solution of a chlorine carrier containing 3 % active chlorine was used to prevent the spread of the pathogen.

Results and discussions

In the result of a year's investigation it became clear that animals' group housing and zoohygienic conditions are considered predisposing factors for infection. As a result of epidemiological, microbiological and microscopic studies, it was determined that miscarriages, death of weak and non-viable piglets was not caused by other diseases, so the research was performed with serological (RBT and AR) methods.

According to Rose Bengal test, a suspicious positive reaction has been observed in 5 sows; the latter has been grounded in the result of rechecking (after 15-30 days) and application of agglutination reaction.

Dilution of swine's blood serum was performed through the test tube method with 2 ratios: 1:25, 1:50, 1:100, 1:200. In sera of known antigen, unknown antibodies were detected at these dilutions, but 1:25, 1:50, and 1:100 dilutions were considered positive diagnostic titers. The positive results of the above stated reactions were observed through the unaided eye, which was evaluated through crosses (+2, +3, +1) or 50 % and 75 % (Figure 3). In order to prevent the possible spread of swine brucellosis pathogens, the given areas were disinfected with a calcium hydrochloride solution containing 3 % active chlorine.

The results of the brucellosis diagnosis through serological methods confirm that these methods are reliable and effective, which can be used in the system of fighting and curing brucellosis. Epidemiological analysis was conducted per the indices of morbidity, infertility (piglets lethality) and insecurity coefficient. It should be mentioned that out of 200 heads of sow 5 heads were infected, and as a result the morbidity index made 0.25 (2.5 %), whereas per the total head number this idex was 0.025 (0.25 %).

It should be mentioned that the economic loss caused by the forced slaugter of diseased animals with 80 kg average weight has been determined per 1 kg meat sale of averagely fattened animal, which made 2500 drams, while in the diseased ones it was 1500 drams. As a result, the damage caused by the forced slaughter of 5 infection carrier sows makes 400 thousand drams. So,

$$Ed = Q \cdot Km \cdot H - Dm =$$
$$= 5 \times 80 \times 2500 - 5 \cdot 80 \times 1500 = 400 \text{ thousand drams.}$$

To determine the economic damage caused as a result of infertility of monoparous sows the price of piglets ($P_p = 9.1$) at the moment of farrowing has been used, where the live weight of the swines made 9.1 kg (Nikitin and Voskoboynik, 1999).

Figure 1. Blood sampling from the inferior tail artery.

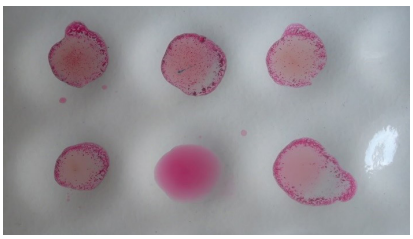

Figure 2. A positive reaction against brucellosis.

Figure 3. Positive results of AR.

It is worth mentioning that in the result of market competitiveness of farm animals 1 kg weight growth of a swine is equal to 2500 drams. The price of a piglet at the moment of farrowing made 22 750 drams.

So, $P_v = 9.1 \times W_g = 9.1 \times 2500 = 22750$ drams.

During the investigations it has been disclosed that due to the infection 1560 piglets were farrowed from 200 heads of monoparous sows instead of 1600 ones and in the result of 40 heads of miscarried foetus the economic damage amounted to 728 thousand drams.

$E_d = F_v (B_g \times F_w - P_{an}) = 22750(8 \times 200 - 1560) = 910$ thousand.

It can be inferred herefrom that in the result of 2.5 % of swine infection the total economic damage has amounted to 1mln 310 thousand drams. In the result of epidemiological research analysis the morbidity and insecurity coefficients make 0.025 (2.5 %), 0.0075 (0.75 %) respectively, while the ecnomic damage makes 1 mln 310 thousand drams.

The rural population, as well as animal owning citizens, being wary of infected animals, as well as the products and raw materials of animal origin, within the framework of their responsibilities, take measures to forcibly slaughter sick and infected animals (Iskandaryan, et al., 2012, Eghoyan, et al., 2018).

Conclusion

The created epidemiological situation is multicausal, where the level of veterinary and sanitary conditions are of utmost significance. Detection of brucellosis among the population raises suspicions about the disease of farm animals.

As for diseased and infection carrier animals, it is forbidden to use their carcasses in a smoked state. According to the directive on the fight and prevention of brucellosis disease, slaughtered pork with a positive result for the strain per laboratory research (Br. Suis) is allowed to be used in the production of sausages and preserves, observing to the procedure for decontamination of meat and meat products (Directive, 2013). In the swine-breeding farms, the adult sows and boars should be examined once a year (through serological method) and in case of slaughter it should be done 30 days earlier.

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